BUILDINGS AS SYSTEMS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF ARCHITECTURE AT
THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PAUL SUN
B.A. TARKIO COLLEGE, MISSOURI 1957
B.ARCH. COLUMBIA UNIVERSITY 1963

LAWRENCE B. ANDERSON, HEAD
DEPARTMENT OF ARCHITECTURE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

JUNE, 1966
DEAR DEAN ANDERSON:

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER IN ARCHITECTURE, I HEREBY SUBMIT THIS THESIS ENTITLED "BUILDINGS AS SYSTEMS"

RESPECTFULLY,

[Signature]

PAUL SUN
ABSTRACT

THE AIM OF THIS THESIS IS TO DESIGN BUILDINGS AS SYSTEMS --- A SYSTEM OF GROWTH, A SYSTEM OF ADAPTABILITY, A SYSTEM OF STRUCTURE.

A SYSTEM TO BE APPROACHED AS AN ORDERLY ORGANIZATION OF COMPONENTS INTERACT WITH EACH OTHER TO RECEIVE MAXIMUM UTILIZATION FROM EACH AND FROM THE WHOLE.

A SYSTEM TO BE CREATED FOR BUILDINGS A NEW SCALE WITH EMPHASIS ON SPATIAL QUALITY AND INTERNAL LIFE.

A BUILDING NEED NOT GROW OBSOLETE, THEY CAN GROW INTERNALLY AND EXTERNALLY FOR ANY CHANGES IN FUNCTION.
ACKNOWLEDGEMENTS

THESIS SUPERVISOR
EDUARDO F. CATALANO

STRUCTURE
WARCKW ZEWLESKI

MECHANICAL EQUIPMENT
SIDNEY GREENLEAF
TABLE OF CONTENT

TITLE PAGE ------------------------------- 1
LETTER OF SUBMISSION --------------------- 2
ABSTRACT ---------------------------------- 3
ACKNOWLEDGEMENTS ------------------------- 4
TABLE OF CONTENTS ------------------------- 5
LIST OF ILLUSTRATION ---------------------- 6
INTRODUCTION ------------------------------ 7
SPACE ------------------------------------- 8
STRUCTURE --------------------------------- 10
MECHANICAL EQUIPMENT ---------------------- 11
CONSTRUCTION SEQUENCE --------------------- 12
ELECTRICAL, LIGHTING, ACoustical AND PARTITION - 13
PRESENTATION DRAWINGS AND PHOTOGRAPH OF MODEL
LIST OF ILLUSTRATION

1. BUILDINGS AS SYSTEMS - EDGE CONDITION
2. SYSTEM OF GROWTH AND ADAPTABILITY - FOOTPRINT
3. SYSTEM OF SPATIAL FLEXIBILITY - SECTIONS
4. PLAN - STRUCTURAL MODULE, CORE, REFLECTED CEILING PLAN AND MECHANICAL DUCT SYSTEM
5. CONSTRUCTION SEQUENCE
6. STRUCTURAL SECTION I
7. STRUCTURAL SECTION II

PHOTOGRAPH OF MODEL
A. GIRDER
B. BEAM I
C. BEAM II
D. STRUCTURE I
E. STRUCTURE II
F. STRUCTURAL VOID I
G. STRUCTURAL VOID II
INTRODUCTION

TO DESIGN BUILDINGS WITH A SYSTEM OF GROWTH BOTH INTERNALLY AND EXTERNALLY. MUST ALSO PROVIDE FLEXIBILITY - PRESENT AND FUTURE.

TO ESTABLISH A FOOTPRINT OF STRUCTURAL AND MAIN MECHANICAL CORE OR BRANCHES AS PERMANENT ELEMENTS OF THE SYSTEM, WHILE ACHIEVE FLEXIBILITY FOR SECONDARY STRUCTURAL AND MECHANICAL COMPONENTS THAT CAN CHANGE OR BE REMOVED PRESERVING THE FUNCTION OF THE SYSTEM.
SPACE

THE SPACE-FLEXIBILITY SYSTEM PROVIDES FOR MAXIMUM INTERNAL FLEXIBILITY BY MOVING MODULAR PARTITION SPACINGS. AN ORDER OR CONTROL OF THE PARTITION ACCOMPLISHED BY ESTABLISHING A GRID UPON WHICH TO BUILD PARTITIONS. ALL SPACE WILL THEN GROW IN INCREMENTS OF THE BASIC UNIT OF THE GRID: THE MODULE.

A MODULE OF 4'X 8' WAS SELECTED ON THE FOLLOWING PREMISES:

1. SMALLEST DESIRABLE WIDTH FOR CORRIDOR CIRCULATION 8'
2. BASIC INDIVIDUAL SPACE 8'X 12'
3. FLEXIBLE SPACING FOR LIGHT-DIFFUSER UNITS.
4. 32'X32' BAY A MULTIPLE OF THE MODULE IS DESIGNED FOR THE CORE AND A GOOD PARKING BAY SPACING.
5. 64'X64' A MULTIPLE OF THE MODULE PROVIDES MAXIMUM FLEXIBILITY IN SIZE OF SPACES AND SIZE OF VOIDS.

TO ESTABLISH THE UNIFORM DEPTH OF EXPOSED BEAM AND GIRDER TO FORM A LOGICAL AND SOUND CONSTRUCTION TERMINATION FOR PARTITION.

THE CORES ARE DESIGNED TO BE MULTIPLES OF THE ESTABLISHED STRUCTURAL BAY. THERE ARE TWO TYPES OF CORE, ONE HOUSES STAIR, ELEVATORS, SERVICE CLOSETS AND MECHANICAL DUCT

PAIRED RECTANGLE COLUMNS LOCATED AT THE SAME DIRECTION OF THE MAJOR GIRDER EMPHASIS THE ONE WAY SYSTEM, IT ALSO REDUCED THE MASS OF THE COLUMN. THE OPENNING AT COLUMNS ALSO EMPHASIS THE LOCATION OF MIXING BOXES AND THE SECONDARY CHANNEL FOR MECHANICAL DUCTS, IT IS POSSIBLE TO INDICATES THE DIRECTION OF CORRIDOR AND POINT OF ENTRANCE OR EXITS.
STRUCTURE

ONE-WAY SYSTEM WITH A MODULE OF 4'x3'.

GIRDERS: 12" X 36" REINFORCED CONCRETE, SPAN 32' NO OPENNINGS.

BEAM I: 6" X 36" PRECAST CONCRETE, SPAN 32'
WITH 12" X 48" OPENNINGS CARRYING MAJOR MECHANICAL SUPPLY AND RETURN DUCTS.

BEAM II: 6" X 36" PRECAST CONCRETE, SPAN 64'
WITH 12" X 24" OPENNINGS CARRYING LOCAL DISTRIBUTION DUCTS.

COLUMNS: 12" X 42" REINFORCED CONCRETE Poured,
IN PAIR SPACED WITH A NOMINAL DIMENSION OF ONE MODULE. PROVIDED OPENNINGS BETWEEN COLUMNS FOR SECONDARY MECHANICAL DISTRIBUTION CHANNEL.

TYPICAL FLOOR TO FLOOR HEIGHT: 14'-0"
MECHANICAL EQUIPMENT

DUAL DUCT HIGH VELOCITY MAIN SUPPLY AT THE CORE.
ALL UTILITY-SERVICE LINES ARE TERMINATED IN A SUB-
BASEMENT AND EXTEND TO THE ROOF OFFERING VERTICAL EXHAUST.
THE COOLING TOWERS ARE LOCATED ON THE TOP OF EACH CORE.
THE BOILERS, FAN ROOMS AND REFRIGERATION EQUIPMENT ARE
LOCATED IN A SUB-BASEMENT MECHANICAL ROOM.
THE PRIMARY HORIZONTAL AIR SUPPLY AND RETURN IS LOW
VELOCITY AND LOCATED IN THE STRUCTURAL CAVITY ABOVE.
MIXING BOXES ARE LOCATED AT EACH COLUMN SPACING OF 32'
AND THE OPENNING FOR SECONDARY SUPPLY AND RETURN CHANNEL.
ALL HORIZONTAL LINES, SO AS NOT TO INTERFERE WITH THE
PARTITIONS, WILL BE HOUSED WITHIN THE STRUCTURAL DEPTH.
DUCT RUN THROUGH OPENNINGS AT BEAMS ONLY, NO OPENNINGS AT
GIRDERS.
EACH MODULE HAS A DIFFUSER-LIGHTING UNIT. EACH OTHER
MODULE HOUSES A SUPPLY DIFFUSER AND EACH ADJACENT MODULE
A RETURN DIFFUSER. PROVIDE PLUG-IN CONNECTION OF SUPPLY OR
RETURN DIFFUSER FOR SPACE REQUIREMENTS.
THE PERIMETER ZONE AIR IS RE-HEATED OR RE-COOLED WITH
FAN COIL UNITS.
CONSTRUCTION SEQUENCE

POUR CONCRETE FOUNDATION
POUR IN PLACE CONCRETE COLUMNS
PLACING PRE-CAST GIRDER
WELDING CONNECTION AT COLUMN AND GIRDER WITH PRE-SET STEEL PLATE CONNECTION.
PLACING PRE-CAST BEAMS
PLACING PRE-CAST CONCRETE DIAPHRAM AND LOCKED IN PLACE.
PLACEING CONCRETE SLABS
PLACE UNDER FLOOR ELECTRICAL DUCT
POUR CONCRETE TOPPING OR ROOFING
FINISH FLOORING OR ROOFING
PLACING MECHANICAL DUCT THROUGH STRUCTURAL CAVITY
PLUG - IN LIGHTING-DIFFUSER UNITS
PLACING ACOUSTICAL PANEL
ELECTRICAL

UNDER FLOOR DISTRIBUTION SYSTEM. SINGLE-LEVEL DUCT
1 7/16" X 6 5/8" RECESSED STAINLESS STEEL JUNCTION BOX
COVER AND TRIM RING FLUSH FLOOR OUTLETS.

LIGHTING

LIGHTING AND DIFFUSERS COMBINE. PLUG IN CONNECTIONS.
SPACING AT EACH STRUCTURAL MODULE.

PARTITIONS

4' X 8' REMOVABLE PARTITION PANNEL WITH BUILT-IN INSULATION.

ACCOUSTICAL

MODULAR ACCOUSTICAL PANNELS PLACED AT EACH STRUCTURAL
OPENNINGS AND AT SIDE OF PRE-CAST CONCRETE BEAMS.
NO CEILING ACCOUSTIC PANNEL.
PRE-CAST UNIT
PERIMETER FAN COIL UNIT

GIRDERS SECTION

BEAM CROSS SECTION

MECHANICAL DUCT SYSTEM

COLUMN CONNECTION
steel bars welded to recessed steel plate

PRIMARY AIR SUPPLY & RETURN CHANNEL
PARTITION
ELECTRICAL RACEWAY
LIGHTING - DIFFUSER UNITS

SECTION 0 1 3
foot

school of architecture - massachusetts institute of technology
master thesis - paul sun
1966
CONSTRUCTION SEQUENCE

1. Precast columns
2. Place main girder
3. Welded connection
4. Precast beams
5. Precast diaphragm
6. Concrete slab
7. Electrical duct
8. Concrete topping
9. Mechanical ducts & pipes
10. Plug-in lighting diffuser units
11. Acoustical panel

School of Architecture - Massachusetts Institute of Technology

Master Thesis 1966